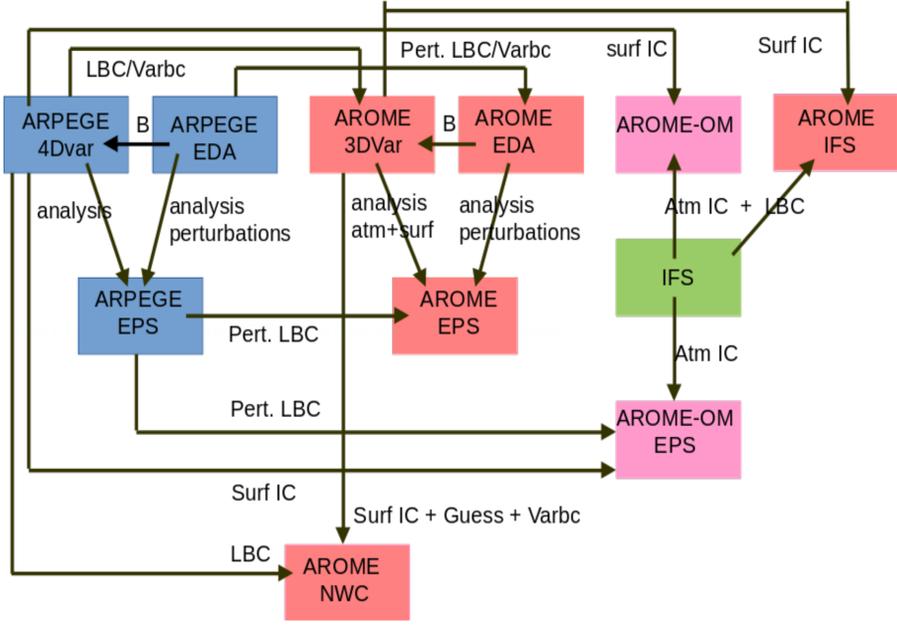


Overview of Météo-France NWP systems

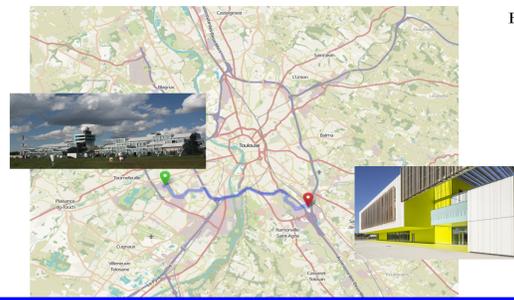
Operational NWP systems



2 HPC, 2 implementations

In operations since February 2021

No upgrade during the 6 year contract



Each HPC: ATOS BULL Sequana XH2000
2292 computing nodes

2 AMD Epyc Rome processors with 64 cores at 2.25 Ghz
10.39 PFlops peak performance

Migration to next HPC is planned in 2027

Global NWP systems based on ARPEGE new version in operation around October 2024

suite: cy48t1_op1

Hybrid 4DVar in OOPS ARPEGE

- 4DVar with 6h cycle : T1224 c1 & T1499 c1
- Hybrid B matrix from ARPEGE-EDA background covariances
- Observations**: "all sky" assimilation of microwave obs (MHS, MWHS2, GMI, AMSR2), ATMS from NOAA-21, ABI from GOES-17, update of R matrix for IASI, GNSS-RO (GRACE-C, Sentinel-6, Spire), WIGOS adaptations
- Physics**: EcRad (McIca solver) radiation scheme, microphysics tunings, Surfex v8.1, use of SST from Mercator-Ocean GLO12, solar eclipse
- Dynamics**: use of WENO interpolations for T and Q in stratosphere
- 4 forecasts per day

ARPEGE-EDA in OOPS

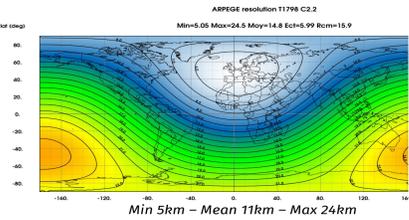
- T1499 c1
- 4DVar with 6h cycle (T1224 c1)
- 50 members
- recentering on the control member

ARPEGE-EPS

- 34 perturbed members + control
- 4 forecasts per day
- Initial perturbations from ARPEGE-EDA + SV

Common features (except otherwise noted)

- T11798 c2.2 (5 to 24 km)
- 240 s timestep
- 105 levels (10 m to 0.1 hPa)
- 102 h forecast lead time



Scores ARPEGE DBL Cy48 versus OPER Cy46 28/04/2023-26/08/2024

REQM	Ref: radiosoundings					Ref: synop				
	EUROPE	NORD20	SUD20	TROPIQUES	GLOBAL	EUROPE	NORD20	SUD20	TROPIQUES	GLOBAL
Temperature 2m	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲
Humidité rel. 2m	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲
Force vent moyen 10m	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲
Direction vent moyen 10m	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲
Press. Mer	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲

References
 • Descamps et al 2015, PEARP, the Météo-France short-range ensemble prediction system. Q. J. R. Meteorol. Soc., 141: 1671-1685
 • Bouysselet et al. 2022, The 2020 Global Operational NWP Data Assimilation System at Météo-France, Data Assimilation for Atmospheric, Oceanic and Hydrologic Applications (Vol. IV)

Regional NWP systems based on AROME new version in operation around October 2024

suite: cy48t1_op1

3DnVar in OOPS AROME

- 3DnVar with 1h cycle +IAU
- EcRad+aerosol/ozone climatologies (CAM5), Surfex v8.1, SST Mercator-Ocean Glo12
- scatterometers HY-2B & HY-2C, Mode-S from EMADDC, GNSS-RO (GRACE-C, Sentinel-6, Spire), ATMS from NOAA-21, MWHS2 from FY3-E, WIGOS adaptations
- 8 forecasts per day

AROME-EPS

- 25 perturbed members + control
- 4 forecasts per day (+ 51h)
- Initial perturbations from AROME-EDA
- SPPT
- LBCs from ARPEGE-EPS
- random surface perturbations

Common features (except otherwise noted)

- 1.3 km, 50s timestep
- 90 levels (5m to 10 hPa)
- 51 forecast lead time
- uncycled forecasts in single precision

AROME-EDA in OOPS

- 3.25 km, 100 s timestep
- 3DVar with 3h cycle
- 50 members

AROME-IFS

- downscaling of IFS
- Arome surface
- 4 forecasts per day

AROME-NWC (Nowcasting)

- 3DVar, guess from 3dvarfr, 10' cut-off
- 24 forecasts per day up

AROME-Overseas (AROME-OM)

- 5 domains, use of mixed precision
- 4 forecasts per day (+78h on demand)
- Downscaling of IFS with prior "warmup"
- Use of Arpege surface (continent)
- 1D ocean model

EPS AROME-Overseas (AROME-OM-EPS)

- 15+1 members at 2.5 km, mixed precision, hydrostatic, SPPT
- 5 domains, 2 runs per day (+78h on demand)
- Use of IFS as unperturbed initial conditions
- Boundary conditions + initial perturbations : ARPEGE-EPS
- Perturbation of surface + ocean layers

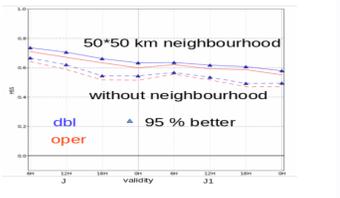
AROME DBL Cy48 versus OPER cy46

Scores cards Normalized differences 28/04/2023-08/09/2024

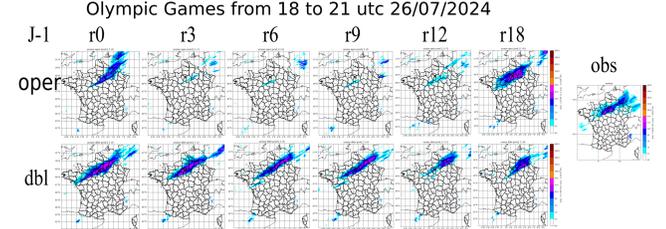
REQM	Reunion	Reunion
Temperature 2m	▲▲▲▲▲	▲▲▲▲▲
Humidité rel. 2m	▲▲▲▲▲	▲▲▲▲▲
Force vent moyen 10m	▲▲▲▲▲	▲▲▲▲▲
Direction vent moyen 10m	▲▲▲▲▲	▲▲▲▲▲
Press. Mer	▲▲▲▲▲	▲▲▲▲▲

REQM	Reunion	Reunion
Temperature 2m	▲▲▲▲▲	▲▲▲▲▲
Humidité rel. 2m	▲▲▲▲▲	▲▲▲▲▲
Force vent moyen 10m	▲▲▲▲▲	▲▲▲▲▲
Direction vent moyen 10m	▲▲▲▲▲	▲▲▲▲▲
Press. Mer	▲▲▲▲▲	▲▲▲▲▲
Press. Sol	▲▲▲▲▲	▲▲▲▲▲
Press. Sfc	▲▲▲▲▲	▲▲▲▲▲
Press. 500	▲▲▲▲▲	▲▲▲▲▲
Press. 850	▲▲▲▲▲	▲▲▲▲▲
Press. 1000	▲▲▲▲▲	▲▲▲▲▲

HSS RR6 >= 2mm 03/05/2023-07/08/2024



forecast of precipitations during opening ceremony of the Olympic Games from 18 to 21 utc 26/07/2024



--> reduced jumpiness = general behaviour

References

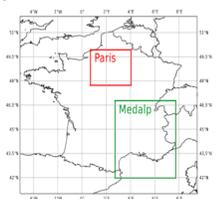
- Brousseau et al 2016, Improvement of the forecast of convective activity from the AROME-France system. Q. J. R. Meteorol. Soc., 142: 2231-2243
- L. Raynaud et F. Bouttier, 2016: Comparison of initial perturbation methods for ensemble prediction at convective scale. Q. J. R. Meteorol. Soc.
- Bouttier et al. 2016 Sensitivity of the AROME ensemble to initial and surface perturbations during HyMeX. Q. J. R. Meteorol. Soc.
- Merlet et al. 2017: Arome for nowcasting, Aladin-Hirlam Newsletter n°9
- Faure et al, 2020: Operational Implementation of the AROME Model in the Tropics, Weather and Forecasting, 35(2), 691-710

Further perspectives 2025-2026 e-suite: cy49t1_op1 (modifications to be confirmed)

- Assimilation**: 4DnVar+SDL (AROME), perturbations of physics' parametrisations with Random Parameter Method and perturbations of obs operator of allsky data (ARPEGE-EDA), 3DnVar +SDL (AROME-EDA)
- Observations** - ARPEGE : Mode-S from EMADDC, satellite snow cover data
 - ARPEGE and AROME : "all sky" assimilation of AMSU-A , GNSS-RO (PlanetIQ), GOES-18 ABI, monitoring of TROPICS, Scatterometers HY-2D and Oceansat3, new thinning for satellite data, improvement of observation errors and QC for AMVs
 - AROME : direct assimilation of ground-based radar reflectivities, monitoring of MTG/LI
- Physics**: Ocean Mixing Layer (ARPEGE), using a Gaussian PDF in the saturation adjustment (AROME)
- Dynamics** : finding the origin of the most efficient SL trajectory
- ARPEGE-EPS**: adaptation to ARPEGE-EDA modifications, Ocean Mixing Layer, perturbation of initial surface states
- AROME-EPS**: random perturbations of parameters in physical parametrisation
- All uncycled ARPEGE forecasts and ARPEGE-EPS forecasts will be run using single precision

AROME@500m 2 domains

- Downscaling of Arome at 00utc
- 120 vertical levels, 20s timestep
- SRTM30 orography database, Ecoclimap-SG300m, Soilgrid250m,
- numerical diffusion of temperature
- +36h over Paris/+24h over MEDALP



Scores

- reduced FF10m overestimation
- reduced night dry HU2m bias
- reduced T2m biases over MedAlp
- correct rainfalls but too small and numerous convective cells

Reference

Antoine, S. Honnert, R., Seity, Y., Vié, B., Burnet, F., Martinet, P.: Evaluation of an improved AROME configuration for fog forecast during the SOFOG3D campaign, Weather and Forecasting, https://doi.org/10.1175/WAF-

46th EWGLAM, PRAGUE
30 September-3 October 2024

